

NOTES

Notes on the Coloration and Behavior of the Common Dolphin, *Coryphaena hippurus*

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WHILE STUDYING scombrid fishes at the Kewalo Basin tank facility of the U. S. Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii, we noted similarities between the behavior of the common dolphin, *Coryphaena hippurus* Linnaeus, and that of the scombrids. These similarities led us to observe the coloration, swimming speed, and behavior of *C. hippurus* incidentally to the studies on scombrids.

Most observations were made on five captive specimens in shoreside tanks during July–September 1962. Additional observations were made at sea through underwater viewing ports from a raft.

The *C. hippurus* specimens had been caught by trolling with barbless hooks, transported in a baitwell of a commercial fishing boat, and transferred at shore by dip net to a portable 2300-l tank from which they were allowed to swim directly into the shoreside tank in the manner described by Nakamura (1962, *Copeia* 1962 (3):449–505). The outdoor tank was circular, 24 ft in diameter, and 3½ ft deep, and had an observation window in its wall. Water temperature in the tank was about 24° C during the day and 22° C at night. Salinity was 33‰.

All five fish eventually jumped out of the tank and died, the last after 45 days in captivity.

The *C. hippurus* averaged 76 cm in fork length and 3.7 kg in weight. They were fed 5–7-gm pieces of beef liver and whole thawed night smelt, *Spirinchus starksi* (Fisk), which weighed approximately 12 gm. When fed at 24-hr intervals, the fish ate 334 gm per feeding, approximately 9% of the body weight.

Although *C. hippurus* have been reported

by many authors to exhibit a changing array of many brilliant colors, their basic coloration in the tanks and at sea varied between two extremes. One was a silver-blue phase similar to that illustrated by the Fisheries Society of Japan (1931, *Illustrations of Japanese Aquatic Plants and Animals*, I, Pl. XXX). The other extreme was a yellowish phase similar to that illustrated by Walford (1937, *Marine Game Fishes of the Pacific Coast, Alaska to the Equator*, Univ. Calif. Press, Berkeley, Pl. 43) and noted by Gibbs and Collette (1959, *Bull. Mar. Sci. Gulf Carib.* 9(2):122) and Rothschild (1964, *Copeia* 1964 (2):445–447). Intermediate shades between these two extremes occurred. The intermediates were various hues of greenish-blue or greenish-yellow and apparently resulted from the combined effects of the blue and the yellow coloration.

In the extreme silver-blue phase the body and caudal fin were silver-blue. The extreme ventral body surface was silver-white. The dorsal fin, the dorsal surface of the pectoral fins, and the lateral surfaces of the pelvic fins were blue. Dark blue spots 3–5 mm in diameter were scattered over the body.

In the extreme yellow coloration, more evident at sea than in tanks, the caudal fin, the anal fin, the outer surface of the pelvic fins and the dorsal surface of the pectoral fins turned bright yellow while the head and body turned greenish-yellow. The same dark-blue spots were present.

C. hippurus observed through underwater viewing ports from a raft, *Nenue*, described by Gooding² tended to take on the yellow coloration just after reacting to food or just after a transient barred coloration described below

¹ U. S. Fish and Wildlife Service, Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii 96822. Manuscript received May 18, 1965.

² Gooding, Reginald M. 1965. A raft for direct subsurface observations at sea. U. S. Fish Wildl. Serv., Spec. Sci. Rep. Fish. 517. 5 p.

faded. The yellow coloration also occurred while *C. hippurus* were struggling on a hook and line or lying on the deck just after capture.

The broad dark vertical bars described by Strasburg and Marr (1961, Copeia 1961 (2): 226-228) were observed in the tank only once and then they were faint. These alternate dark and light vertical bars about 5 cm wide formed on the lateral surfaces of the *C. hippurus* when a live 25-cm *Tilapia mossambica* was tossed into the tank after the *hippurus* had not been fed for 10 days. The bars were displayed during an attack by the *hippurus* which ended with the consumption of the *T. mossambica*. A more prominent barred coloration was observed at sea after chopped meat was tossed in front of two *hippurus* swimming around the observation raft, and while the *hippurus* were attacking species of smaller fishes congregated at the raft.

The *hippurus* in the tanks swam continuously day and night with an undulating body movement, mouth agape and pectoral fins extended. During turns of 90° or sharper, the dorsal fin was raised slightly. The left pelvic fin was extended during gradual left turns; the right during gradual right turns. The typical swimming speed of a 71.1-cm *hippurus*, measured on three different days over a one-week period, was 56.3 cm/sec (0.79 body length/sec) (95% confidence interval: 54.8-57.8 cm/sec; $n = 31$ 30-sec observations, $s^2 = 19.32$). At this speed approximately 50 km would be traversed in a 24-hr period. The typical tail-beat frequency was 1.21 beats/sec (95% confidence interval: 1.10-1.32 beats/sec; $n = 31$, $s^2 = 0.09256$). A tail beat is defined as a complete cycle back and forth. At the typical speeds the fish was moving 46.5 cm/tail beat or 0.654 body length/tail beat. Motion pictures taken from the raft showed the average tail-beat frequency of *C. hippurus* about 100 cm in fork length swimming near the raft to be 1.20 beats/sec (95% confidence interval: 1.14-1.27 beats/sec; $n = 8$, $s^2 = 0.009143$), essentially the same as in the tank. The surface temperature was 27° C, only 3° C higher than the daytime tank temperatures.

These slow rates of swimming are those most commonly observed for *C. hippurus* both in tanks and at sea. Since they never stop swim-

ming, these are as close to resting speeds as the animal attains. These dolphins apparently irrigate their gills by forward progression through the water and maintain swimming depth by the hydrodynamic lift exerted against the pectoral fins. They do not have a gas bladder. These same functional components (respiration and hydrostatic equilibrium) of locomotion in pelagic fishes have been noted previously for scombrids (Breder, 1926, Zoologica 4(5):159-297; Hall, 1930, Am. J. Physiol. 93(2):417-421; Magnuson and Prescott³, Nakamura, op. cit.) and are probably a very common adaptation of locomotion in pelagic fishes.

Several characteristic behavior patterns were observed among the *C. hippurus* in captivity. These were named mouth closure, oral valve closure, yawn, lean, chafe, jerk, and defecation. All of these, plus surfing, also were observed at sea. Their occurrence both in captivity and at sea suggests that they are naturally occurring behavior patterns in the repertoire of *C. hippurus*. A brief description of each, based primarily on the tank observations, is presented here.

Mouth closure. The mouth is closed completely for 1-5 sec and then reopened to the typical 2- to 5-cm gape.

Oral valve closure. For periods of less than 1 sec, the mouth is closed partially from the typical gape in such a way that the oral valve appears to close completely. The mouth then is reopened to the typical gape.

Yawn. The mouth is opened maximally, the gular region is depressed, the opercles are flared, all fins are extended, and all caudal motion is stopped. Typical posture and locomotion are disrupted for 3-4 sec.

Lean. The body is tipped to the side at angles of 45-90°. Sometimes this results during a turn as a continuation of a banking posture, but occasionally it results from a quick tipping movement while following a straight course. Then the dorsal fin is extended, as are the pectoral and pelvic fins on the side toward the surface.

³ Magnuson, John J., and John H. Prescott. 1966. Courtship, locomotion, feeding and miscellaneous behaviour of Pacific bonito (*Sarda chiliensis*). Anim. Behav. 14(1):54-67.

This swimming posture is maintained for 3–10 sec and ends with a sudden return to the upright swimming posture.

Chafe. While swimming past an object, the fish brushes or rubs the lateral body surface against the object. If the chafe is directed against the tank's standpipe or sides, the normal upright swimming posture is maintained, but if the object chafed against is above the dolphin, the chafe occurs in conjunction with a lean.

Jerk. A single shudder or quiver passes over the body without visibly affecting locomotion.

Defecation. A brownish-green cloud of fine material was ejected for a 1–3 sec period during typical swimming behavior.

Surfing. The fish swims downwind just beneath the surface, positioning itself in front of a wave crest. The anterior-posterior axis of the

body is inclined from the horizontal at approximately the same angle as the lead surface of the wave. With little or no caudal movement the fish travels rapidly forward in a horizontal plane at the same speed as the wave crest.

The mouth closure, yawn, lean, and jerk of *C. hippurus* appear very similar to patterns observed in another pelagic fish, the Pacific bonito *Sarda chiliensis* (Cuvier) (Magnuson and Prescott, op. cit.). Other similarities are the transient vertically barred coloration, shared also with the skipjack tuna, *Katsuwonus pelamis* (Linnaeus) (Nakamura, op. cit.), and continuous swimming. These similarities in behavior between a coryphaenid and a scombrid suggest that the functions may also be the same and are perhaps common to many pelagic predaceous fishes.